

Jin MURATA* & Junichi OHNO**: *Arisaema ehimense*
**J. Murata et Ohno (Araceae), a new species from
Shikoku, Japan, of putative hybrid origin**

邑田 仁*・大野順一**: テンナンショウ属の新種
エヒメテンナンショウ

Japan is a center of diversity for *Arisaema* sect. *Arisaema* and about 25 species are recognized (Ohashi & J. Murata 1980, Serizawa 1980a, 1980b, 1981a, 1981b, 1982, 1986, J. Murata 1986a, 1986b). Most of them are diploids with $2n=28$ chromosomes (J. Murata & Iijima 1983), and are interfertile to produce F_1 hybrids having high pollen fertility when artificially crossed (usually more than 70%). In nature, distribution ranges of these species overlap each other and there are many places where several species grow together. Among those places, putative interspecific hybrids, recognized by their intermediacy in morphology, are occasionally found (Tab. 1), but usually they do not form populations and seem to go extinct in a short time. In the present new species, *Arisaema ehimense* J. Murata et Ohno, two populations have been found in Ehime Prefecture, Shikoku. This species is morphologically intermediate between *A. serratum* (Thunb.) Schott and *A. tosaense* Makino, and the spathe is very similar to that of their artificial hybrid, which suggests a hybrid origin between these two species for *A. ehimense*. It may be considered, therefore, as an example of hybrid speciation on the homoploid level, through the process of recombinational speciation (Grant 1981).

Materials and methods Field observations and collections of *A. ehimense* were made in two populations in Ehime Prefecture (Fig. 2). Living plants were transplanted and cultivated at Iwaidani, Ehime Prefecture and also in the Botanical Gardens, Faculty of Science, The University of Tokyo. The lengths of the pseudostem, petiole and peduncle were measured on flowering individuals (76 males and 26 females) in habitat. The length and width of the spadix-

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Fig. 1. *Arisaema himense* J. Murata et Ohno.

Tab. 1. Putative natural hybrid in Japanese *Arisaema* sect. *Arisaema*.

1. *A. kishidae* × *A. serratum*: Nara Pref., Uda-gun, Muro-mura, Mt. Sumitsuka-yama, ca 500 m, Mar. 23, 1965, T. Kodama 10561 (OSA).
2. *A. monophyllum* × *A. serratum*: Gunma Pref., Nakazato-mura, Mt. Kanosan, 600-1000 m, May 20, 1983, J. Murata et al. 10523 (TI).
3. *A. monophyllum* × *A. serratum*: Gunma Pref., Nakazato-mura, Mt. Kanosan, 650 m, Apr. 30, 1979, J. Murata et al. 7333 (TI).
4. *A. monophyllum* × *A. serratum*: Gunma Pref., Kiryu-shi, Mt. Narukamiyama, 500 m, May 9, 1974, T. Morita 695 (TI).
5. *A. serratum* × *A. angustatum*: (Serizawa 1975).
6. *A. sikokianum* × *A. tosaense*: (Murata 1962).
7. *A. sikokianum* × *A. yamatense* ssp. *yamatense*: (Ohno & Tsukada 1986):
8. *A. yamatense* × *A. angustatum*: Nara Pref., en route from Namego to Gyoja-gaeri, in Ohmine Mts., ca 1500 m, Jun. 1, 1964, Iwatsuki & Koyama 416 (TNS).
9. *A. yamatense* × *A. serratum*: Osaka Pref., Mt. Kongo-san, May 24, 1968, M. Togashi s.n. (TI).
10. *A. yamatense* ssp. *sugimotoi* × *A. serratum*: Yamanashi Pref., Nanbu-machi, Utsubuna, Apr. 30, 1986, J. Murata 30017 (TI).
11. *A. yamatense* ssp. *sugimotoi* × *A. serratum*: Gifu Pref., along a small ravine (Wasa-dani), being south of Kamimura, Hisaka, Kuze-mura, Ibi-gun, ca 400-600 m, Apr. 28, 1985, H. Takahashi 8949 (KYO).
12. *A. yamatense* ssp. *sugimotoi* × *A. serratum*: Gifu Pref., en route from the Hisaka Skiing Ground to the top of Mt. Kaizuki-yama, Hisaka, Kuze-mura, Ibi-gun, ca 600-900 m, May 23, 1984, H. Takahashi & Takano 32 (KYO).
13. *A. undulatifolium* × *A. serratum*: Gunma Pref., Nakazato-mura, Mt. Kanosan, 600-1000 m, May 20, 1983, J. Murata et al. 10524 (TI).

appendage were measured on dried specimens. Measurements for these five characters were also made on specimens of *Arisaema serratum* collected from Shikoku and the adjacent Setonaikai area and *A. tosaense* deposited in KYO, TI and TUS, then compared using scatter diagrams with the data from *A. ehimense*.

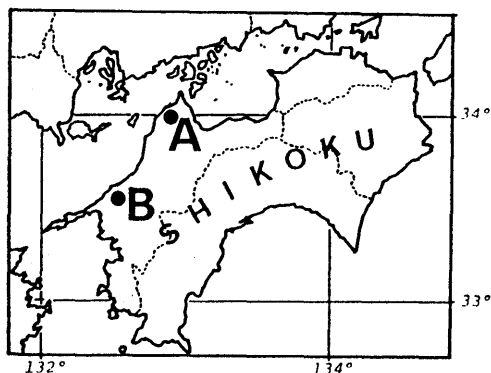


Fig. 2. Location of the populations of *Arisaema ehimense* examined. A: Ehime Pref., Hojo-shi, Yokodani, alt. 200-250 m. B: Ehime Pref., Ozu-shi, Izushi, alt. 15-200 m.

Artificial hybrids were produced in April 1985 between *Arisaema serratum* (J. Murata 5057, a female from Mt. Kongosan, Nara Pref.) and *A. tosaense* (J. Murata 30010, a male from Miyajima Is., Hiroshima Pref.) in the Botanical Gardens, The University of Tokyo (voucher specimens J. Murata 30011-30014).

Pollen stainability with aceto-carmin was examined

in *A. ehimense* (36 specimens), *A. tosaense* (32) and *A. yamatense* (Nakai) Nakai subsp. *yamatense* (26).

For chromosome observations, root tips of cultivated material were pretreated with 0.1% colchicine for 4 hours at room temperature, fixed in a 3:1 mixture of absolute alcohol and acetic acid, then macerated with 1 N HCl, stained by Schiff solution, and squashed.

Voucher specimens used for examination are deposited in TI.

Results and discussion *Arisaema ehimense* is distinct from any other species of *Arisaema* sect. *Arisaema* by the opaque green spathe prolonged into a long declining filiform tip. As a result of cytological examination, it was found to be diploid with $2n=28$ chromosomes. There are at least two populations of this species which are 50 km apart from each other (Fig. 2). Populations A and B consist of about 250 and more than 600 individuals respectively, including juvenile plants of various size as well as males and females, and show a certain range of morphological variation (Figs. 3-5, for example). Pollen stainability averaged $83.7 \pm 21.8\%$ in 36 individuals (males); a figure not distinctly lower than in other species of *Arisaema*, such as *A. yamatense* subsp. *yamatense* ($88.9 \pm 6.1\%$ average in 26 individuals) and *A. tosaense* ($86.1 \pm 15.4\%$ average in 32 individuals). Seeds collected from the female plants of population A, in October 1987, germinated well in the next spring. These facts suggest that *A. ehimense* is an established breeding species.

At present, *A. ehimense* appears to be isolated from both *A. serratum* and *A. tosaense* in geographical distribution and/or in flowering season: *A. ehimense* occurs between 200-250 m above sea level in the population A and 15-200 m in the population B, while *A. tosaense* occurs higher than 600 m in the neighbourhood. *Arisaema serratum* has not been found around the populations of *A. ehimense*. *Arisaema ehimense* was found to flower at the same time as *A. serratum* but about three weeks later than *A. tosaense*, when they were cultivated together at Iwaidani, Ehime Prefecture.

The gross morphology of *Arisaema ehimense* appears intermediate between *A. serratum* and *A. tosaense* in its character association (Tab. 2). The spathe-blade of *A. ehimense* is similar to that of *A. tosaense* in having long filiform tip (Fig. 6); the leaflets are also frequently prolonged into slender tip in both species. On the other hand, *A. ehimense* is similar to *A. serratum* in the size of the spadix appendage; the ranges of size-variation show that the spadix appendage of these two species is generally smaller than in *A. tosaense* and almost distinctly so in female plants (Fig. 3). In the length of the pseudostem and petiole the range of variation in *A. ehimense* is also closer to that of *A. serratum* than in *A. tosaense* (Fig. 4). In the length of the peduncle and petiole, the range of variation in male plants of *A. ehimense* stands intermediate between *A. serratum* and *A. tosaense* (Fig. 5). Differences between male and female are not distinct in *A. serratum* and most distinct in *A. tosaense*; *A. ehimense* shows an intermediate pattern (Figs. 3-5).

Tab. 2. Comparison of the character states of *Arisaema serratum*, *A. ehimense* and *A. tosaense*.

	<i>A. serratum</i>	<i>A. ehimense</i>	<i>A. tosaense</i>
spathe apex (Fig. 6)	acuminate	prolonged	prolonged
leaflets apex	acute to acuminate	cuspidate	cuspidate
spathe translucency (Fig. 6)	opaque	opaque	translucent
spadix appendage size (Fig. 3)	small	small	large
pseudostem length (Fig. 4)	long	intermediate	short
peduncle length (Fig. 5)	long	intermediate	short
sexual differentiation in morphology (Figs. 3-5)	not distinct	intermediate	distinct

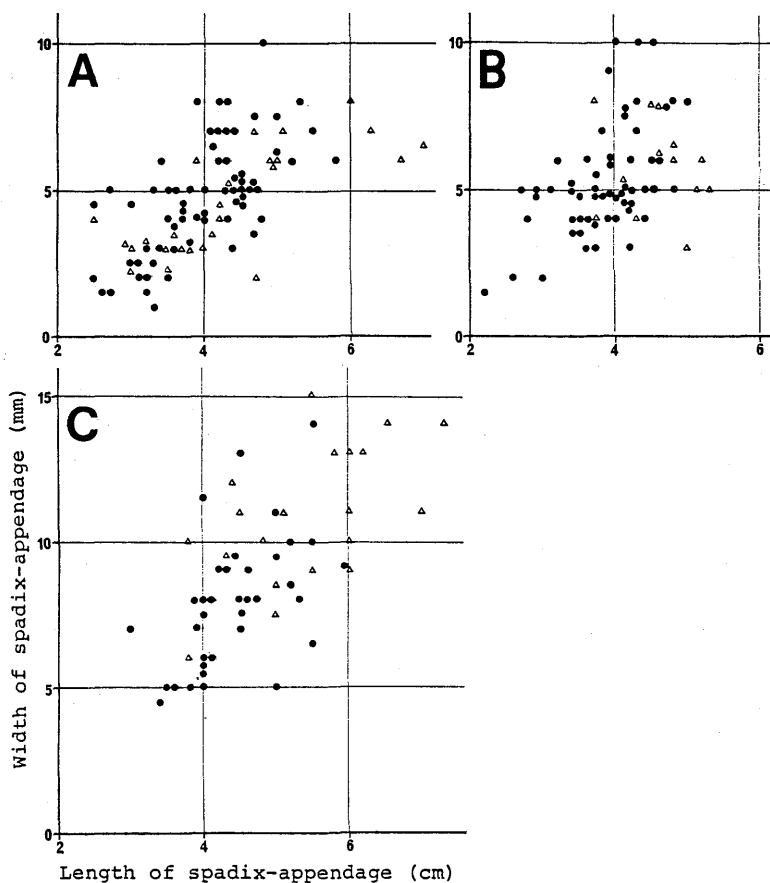


Fig. 3. Variation in the length and width of the spadix-appendage in *Arisaema serratum* from Shikoku and the Setonaikai area (A), *A. ehimense* (B) and *A. tosaense* (C). The males and females are represented by solid circles and open triangles, respectively.

Intermediacy in such various characters seems to be more likely to have occurred through hybridization of the two putative parental species, *Arisaema serratum* and *A. tosaense*, than through a change of each character in a single species. As both suspected parental species grow abundantly in Shikoku and in adjacent Setonaikai area, hybridization is possible between them. The fact that the spathe of *A. ehimense* is very similar to that of the artificial hybrid (Fig.

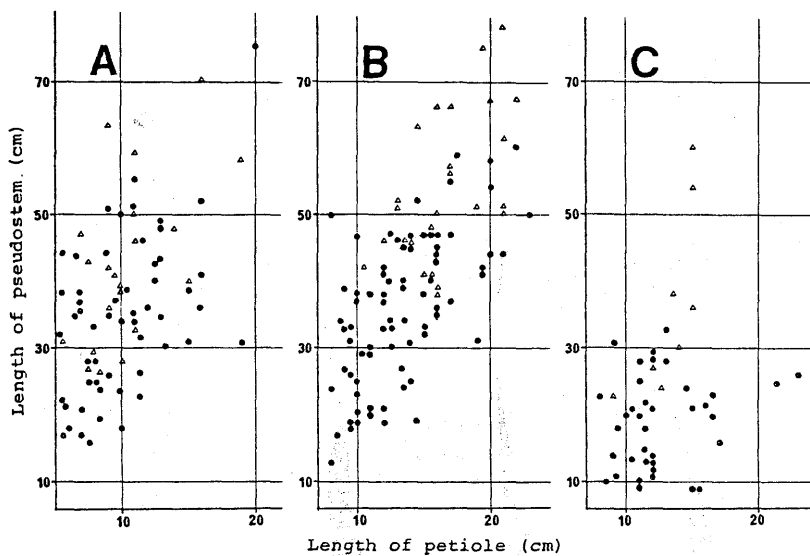


Fig. 4. Variation in the length of the petiole and pseudostem in *Arisaema serratum* from Shikoku and the Setonaikai area (A), *A. chimense* (B) and *A. tosaense* (C). The males and females are represented by solid circles and open triangles, respectively.

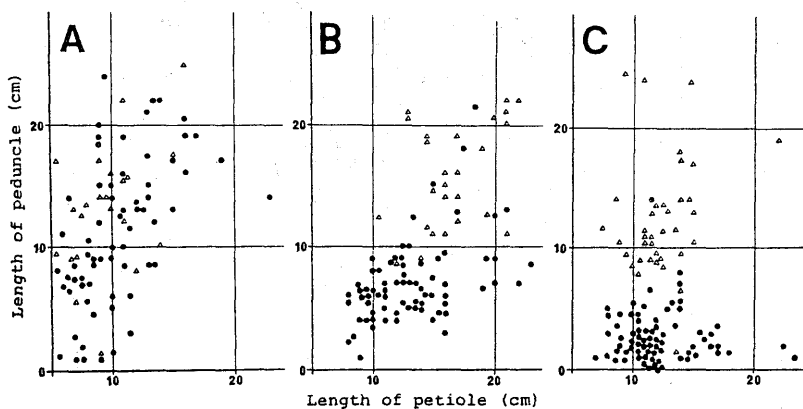


Fig. 5. Variation in the length of the petiole and peduncle in *Arisaema serratum* from Shikoku and Setonaikai area (A), *A. chimense* (B) and *A. tosaense* (C, revised from J. Murata 1986b). The males and females are represented by solid circles and open triangles, respectively.

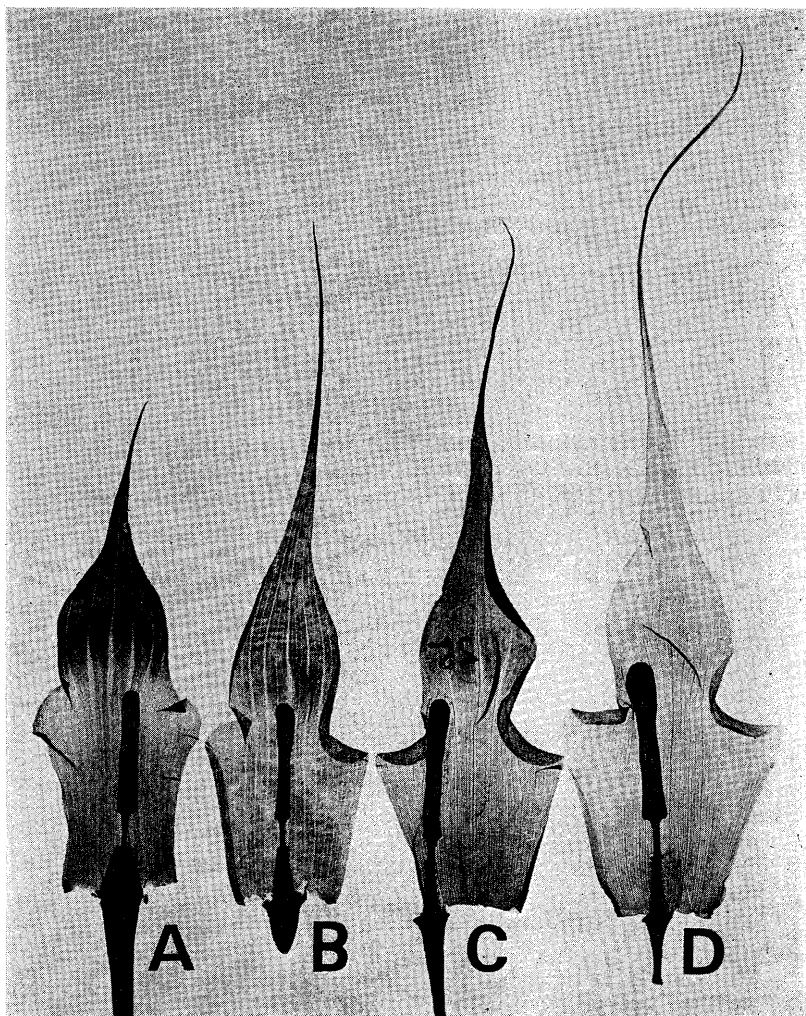


Fig. 6. Spathes of *Arisaema serratum* (A: J. Murata 5057), an artificial hybrid between the two species (B: J. Murata 30011), *A. chimense* (C: Ohno & J. Murata 35) and *A. tosaense* (D: J. Murata 9664-c).

6) supports this hypothesis.

Arisaema chimense J. Murata et Ohno, sp. nov. (Fig. 1), ex affinitate *A. serrato* et *A. tosaensi* sed a priore spatha valde caudato, a posteriore pseudocaule

longiore, spatha non translucido differt.

Typus. Japan, Ehime Pref.: Hojo-shi, Yokodani, W. of Mt. Takanawasan, 200-250 m, May 18, 1987, Ohno & J. Murata 49 (holotype TI, isotype TUS).

Paradioecious unisexual. Pseudostem (13-)20-58 cm long and (1.5-)2-3 times longer than the petiole in male, 37-75 cm long and 2.5-3 times longer than the petiole in female. Leaves 2, petiole 8-22 cm long in male, 10.5-22 cm long in female; lamina pedate, leaflets oblong, cuneate at the base, caudate to the apex, 7-9(-13) in male, 11-13(-17) in female; innermost sections of axes of lateral leaflets (adjacent to terminal leaflet) 3.2-7.5 cm long in male, 4-8 cm in female. Peduncle 5-13(-22)cm long and usually shorter than the petiole in male, 9-22 cm long and usually longer than the petiole in female. Spathe greenish; tube cylindrical, narrowly auriculate at the mouth, 2.8-6 cm long, 2-6.5 cm wide when open; lamina green, with some vertical white lines in the lower part, ovate-lanceolate, gradually narrowed into a long filiform tail and declining in the upper part, 10.5-25 cm long, 2.2-4.0 cm wide. Spadix-appendage stipitate, cylindrical or slightly clavate, entirely greenish or frequently dark-purple in the upper half, 2-5 cm long, 1.5-10 mm wide. Ovule 4-9 per ovary.

Chromosome number $2n=28$ (J. Murata 30015 TI).

Distribution. Japan, Ehime Prefecture: Ozu-shi, Izushi, 15-40 m, Apr. 16, 1989, Ohno & Hyodo s. n. (TI); *ibid.* May 3, 1989, Ohno 111-115 (TI); Nishi Uwa-gun, Igata-machi, Ikata-goshi, Tainoura, Apr. 30, 1965, Y. Nomura 27 (KYO); Nishi Uwa-gun, Honai-machi, Heikedani, Jun. 10, 1969, Y. Nomura 62 (KYO); Nishi Uwa-gun, Honai-machi, Tsuzumio, May 3, 1959, Y. Nomura 19 (KYO); Hojo-shi, Yokodani, W. of Mt. Takanawasan, 200-250 m, May 18, 1987, Ohno & J. Murata 1-57 (TI); *ibid.* May 2, 1989, Ohno 116 (TI).

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Literature cited

- Grant, V. 1981. Plant speciation, second edition. 563 pp. Columbia Univ. Press, New York. Murata, G. 1962. Taxonomic notes 7. Acta Phytotax. Geobot.

19: 68. Murata, J. 1986a. A revision of the *Arisaema amurense* group (Araceae). Journ. Fac. Sci. Univ. Tokyo, III, 14: 49-68. ——— 1986b. Comments on the taxonomic characters and taxonomy of Japanese *Arisaema* (Araceae). (2) Length of the peduncle and the number of ovules per ovary, with special reference to *A. kishidae* Makino and *A. undulatifolium* Nakai. Acta Phytotax. Geobot. 37: 27-41. ——— & M. Iijima 1983. New or noteworthy chromosome records in *Arisaema* (Araceae). Journ. Jap. Bot. 58: 270-280. Ohashi, H. & J. Murata 1980. Taxonomy of the Japanese *Arisaema* (Araceae). Journ. Fac. Sci. Univ. Tokyo, III, 12: 281-336. Ohno, J. & M. Tsukada 1986. *Arisaema yamatense* × *sikokianum*, a new natural hybrid of *Arisaema* (Araceae) in Japan. Journ. Jap. Bot. 61: 89-90 (in Japanese). Serizawa, S. 1975. *Arisaema* of Tokyo-to. Tokyo-to no shizen no. 3, 1-7 (in Japanese). ——— 1980a. Studies on the genus *Arisaema* in Japan (1). Group of *Arisaema undulatifolium*. Journ. Jap. Bot. 55: 148-156. ——— 1980b. *ibid.* (2). Group of *Arisaema yamatense*. Journ. Jap. Bot. 55: 353-357. ——— 1981a. *ibid.* (3). Group of *Arisaema nikoense*. Journ. Jap. Bot. 56: 90-96. ——— 1981b. *ibid.* (4). *Arisaema amurense* group and *A. longipedunculatum* group. Acta Phytotax. Geobot. 32: 22-30. ——— 1982. *ibid.* (6). Group of *Arisaema maximowiczii*. Journ. Jap. Bot. 57: 85-90. ——— 1986. Supplementary notes on the classification of *Arisaema nikoense* s. lat. Journ. Jap. Bot. 61: 22-29.

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愛媛県産の新種エヒメテンナンショウ *Arisaema ehimense* J. Murata et Ohno を記載・発表する。本種は仏炎苞基部の先端が著しく尾状となり長く斜めに垂れ下る点でアオテンナンショウに似るが、半透明になることはなく、異なっている。約 50 km 離れた少くとも 2 つの集団を形成しており、各集団は種子繁殖で維持されていると考えられる。2 集団はそれぞれ 250 個体および 600 個体以上からなることを確認した。

エヒメテンナンショウは一見したところマムシグサとアオテンナンショウの中間的である。形質毎に比較すれば、仏炎苞や葉の先端が尾状となる点でアオテンナンショウに近く、花序付属体の長さや幅、偽茎と葉柄の長さを散布図に示すと、その変異域は逆にマムシグサに近い (Fig. 3, 4)。花梗と葉柄の長さを示す散布図では、雄株に関してはマムシグサとアオテンナンショウの中間に位置する (Fig. 5)。また、雄株と雌株の形態の差 (2 次性徴の違い) は概してマムシグサでは少く、アオテンナンショウで最も顕著であり、エヒメテンナンショウは中程度である。このような形態の中間性から、エヒ

メテンナンショウがマムシグサとアオテンナンショウの交雑によって起源したと推定した。四国や瀬戸内海の島にはマムシグサもアオテンナンショウも普通であり、自然交雑の起る可能性は十分にある。また、マムシグサとアオテンナンショウを人工交配して作った雑種と仏炎苞の形状がよく似ていることもこの仮説を支持している (Fig. 6)。本種の花序付属体は、下部が緑色で上部はしばしば紫褐色となる。一般に、他の形態の中間性から雑種と考えられるテンナンショウ属の個体では、花序付属体の上部と下部とで、質や色彩に明らかな差があることが多い。

□金属鉱業事業団：昭和63年度レアメタル賦存状況調査報告書 218 pp. 1989. 同事業団。非売品。地下の特定の鉱物の存在を示す植物のことは聞いていたが、日本でもこれを真面目に調査する動きがある。鹿児島県で、既知の金鉱床を横切る約 1 km の帯状区間でいろいろな植物を採り、葉の分析値を主成分分析した結果、鉱床上とその前後では金の含量にかなりの差があることが報告されている。とくにヤブムラサキでは顕著であった。土壌の分析値よりも葉の方が指標としての有効性が高いという。こういう手法が確立されれば、過去と現在の標本を比較して、環境中の物質（とくに重金属）の変遷を論ずることが可能となるので、ハーバリウムの存在意義が再認識されるにちがいない。専門機関なので、分析を海外に依存しない方がよいと思う。(金井弘夫)

□大場秀章：秘境・崑崙を行く (岩波新書76) 194 pp. 1989. 岩波書店、東京。¥490。水があるのに植物が生えていないという環境は想像がむづかしい。本書は旅行記であるが、新しい状況に直面した著者のつぶやきがちりばめられており、触発される多くのものを含んでいる。大勢の中国人研究者の中に一人まじっての行動も、いわゆる海外調査とは様子の違うもので、今後の研究協力のあり方の参考となる。(金井弘夫)

□林 弥栄 (監修)、平野隆久 (写真)、畔上能力・菱山忠三郎・西田尚道 (解説)：山溪ハンディ図鑑 1, 野に咲く花 623 pp. 1989. 山と溪谷社、東京。¥2,900 (税込)。どのページも花満載で印刷も美しい。大きな生態写真と共に、いろいろの角度から見た花やその細部、果実などの小型写真が並び、その合計約 2,400 枚だという。この超アップ写真が特徴で、線画とは一味ちがったループで見える感じは大変わかりやすい。解説を分担された 3 氏は実地に大変詳しい方々で、要領よく丁寧に書いておられるので、超アップ写真と相まって初めての人でも「あ、これだ」とすぐわかるにちがいない。20×12 cm の大きさ、厚さも約 2 cm で扱いやすい。(伊藤 洋)